UPDATED INFORMATION ABOUT THE ADIANTUM CAPILLUS-VENERIS DEPOSITS IN KARDZHALI REGION, BULGARIA

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Abstract

In the present report we announce a new habitat of the kind of fern, rare in this country, Adiantum capillus-veneris in the environs of the city of Kardzhali. The plant is one of the few species surviving after the last ice age. The species is protected under the Law of Biologic Diversity and is included in Bulgaria's Red Book as critically threatened. Two of the habitats in the country are in the District of Kardzhali and in the category of protected area. In the register of the Executive Agency of the Environment of protected areas and the protected zones in Bulgaria, they are indicated as a "Habitat of Adiantum Raddianum" at the city of Kardzhali and Oreshari.

The newly found habitat is not present in the register of the Executive Agency of the Environment, is not mentioned as known and protected by the Regional Inspectorate of the Environment and Waters, Haskovo, or by the Protection of the Environment department of Kardzhali Municipality.

Keywords: *Adiantum capillus-veneris, protected territories, protected areas, Bulgaria's Red Book*

1. INTRODUCTION

The Eastern Rhodopes occupy a small part of the total area of Bulgaria, only 5.4% (6,005 km²), but many endemic rare and protected plant and animal species have been found here. The relief is predominantly hilly and lowland, with rounded ridges, steep slopes cut by dry ravines, with a main altitude between 180 and 750 m. The climate is transitional-continental with a pronounced Mediterranean influence along the rivers Arda and Byala.

In the National strategy for preserving the biologic variety the Eastern Rhodopes are defined as a territory of a "high" significance in respect of its variety of species, the significance regarding the endemism as well as the presence of rare taxa [1]. 1,950 species of plants from 122 families, 350 species of butterflies, 21 species of fish, 10 species of amphibians, 26 species of reptiles, 273 species of birds and 59 species of mammals have been identified. The predominant floral elements are sub-Mediterranean and Euro-Asian, followed by Mediterranean. The endemic floral element is represented by 85 Balkan, 20 Bulgarian and 7 Rhodope endemic plant species. There are 28 relict species. For 25 species the only localities are here, 23 are included in the European list of rare, endangered and endemic species (Geneva, 1991), 12 are globally rare European species, 37 species are included in Annex 2 of the Washington Convention (CITES) , 5 species - in the Bern Convention [2].

In the Report on the state of the environment in 2020, in the territory of the RIEW – Haskovo, there is declared, under the Law of protected territories (LPT), a total of 94 Protected territory (in the sense of LBV) (PT's), of which 50 Natural sights (NS's), 4 maintained ones and 1 strict reservation and 39 Protected area (PA's), on an overall area of roughly 10559,692 hectares [2]. The habitats of Adiantum capillus-veneris in the District of Kardzhali are two the 36 protected areas in the territory of the RIEW – Haskovo (Fig. 1).

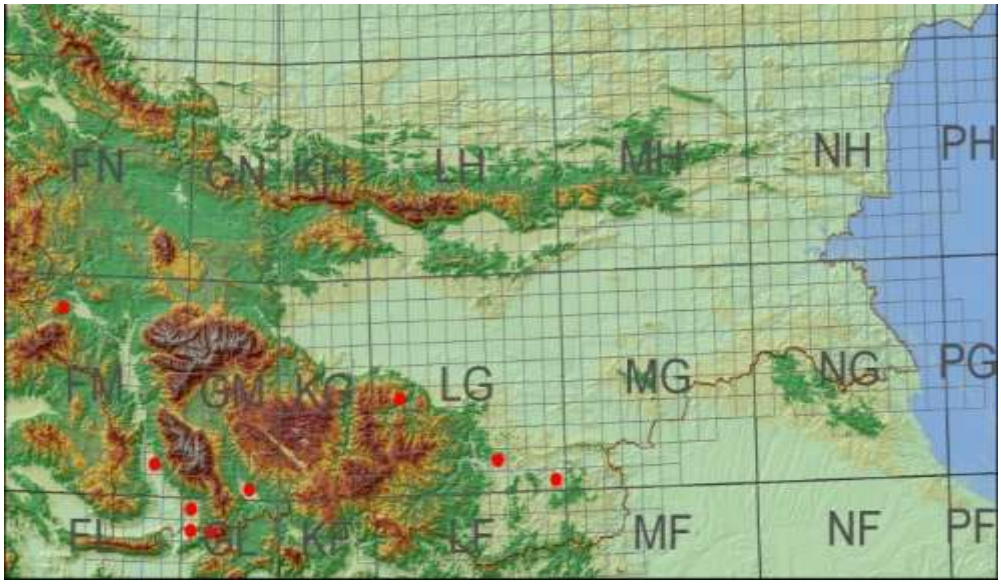


Fig. 1. *Adiantum capillus-veneris*

Source: map in the Red book, vol. 1, 2011

In the specialized literature, Adiantum capillus-veneris is described as a plant of the fern family forming long subterranean roots, whose surface is covered with numerous narrow rust-brown scales. Above ground rise leaves with smooth, dark and shiny petioles whose nodes end in tender thin little leaves (Fig. 2).



Fig. 2. *Adiantum capillus-veneris*

Source: Illustration in the Red book, vol. 1

Each little leaf has a wedge-shaped narrow base and dichotomously branched nerves. The top of the leaf sectors is indented between the nerves' nodes. In the spaces between the indentations, the leaf edge tucks in and covers cups of sporangia. Because of that, the general outlines of the leaf top are wavy (Fig. 3). The spores get mature in August [3].



Fig. 3. *Adiantum capillus-veneris*

Source: Photograph, K. Todorova

Adiantum capillus-veneris, or as the people call it, Mother-of-God hair, got its name from the numerous thin petioles which with its metal sheen and dark cherry and brown to black tint do resemble feminine hair [4]. The plant has an application in popular medicine.

Adiantum capillus-veneris demands special ecologic conditions. It only grows in protected, warm, moist places, on travertine limy rocks and at a constant temperature and moisture. It doesn't tolerate stuffiness or low temperatures. The species has been included in Bulgaria's Red book. In vol. 1 "Plants and mushrooms" and in vol. 3 "Natural habitats", it has been marked in the "critically threatened" category. There we have the description of the characteristic conditions of habitats of this kind of fern – 200-1000 m above sea level, specific hydrological conditions characterized by continuously moistened carbonate rocks of porous lime (travertine) [5,6].

The phytocoenoses of Adiantum capillus-veneris belong to the class, widespread mainly in the Mediterranean region, of *Adiantetea*, specific with its phytogeography distribution and the peculiarities of ecologic conditions in which it is found. The habitats' content of kinds includes chasmophyte cenoses, calcicolous travertine-forming mosses – *Conocephalum conicum, Eucladium verticillatum, Palustriella commutata*, the angiosperms, chiefly represented by moisture-loving and shade-resistant species as *Epilobium spp., Eupatorium cannabinum, Mycelis muralis* etc., and in spots longer irrigated, the deposits of green and blue green algae. In all found grounds, the habitat covers very limited areas and is strongly dependent on the period of moisturizing. If a longer dry period occurs, the phytocoenoses of Adiantum capillus-veneris fall into an inactive state, the plants' capability to renew their normal functions depending also on the meteorological conditions during the year [6].

On a worldwide plane, the species is almost cosmopolitan. It is spread in the warm temperate and the tropical zones, Western and Southern Europe, the Crimea, North, Central and South Africa, Madagascar, Asia, North and South America, Australia, Polynesia.

In this country, the plant can be found in few places – the Rhodope and Slavyanka mountains, in the region of Kyustendil, too [7]. Two of the habitats are in the territory of the Kardzhali municipality. One is registered in the LPT as the "habitat at Oreshari" situated in the land of the village of Oreshari, the Krumovgrad municipality, and covers an area of 55 hectare. The location was pronounced as protected aiming at preserving the habitats and the populations of protected plant and animal species including the Adiantum capillus-veneris as one of the established 4 kinds of relict protected plants together with the yew, the Lathraea rodopaea and the plane-tree [8]. The second habitat is istuated in the locality Kyosh dere – west of Kardzhali at 0.5 km from the estuary of the river of Arda, measuring 1.5 hectare. In the register of Bulgaria's PT and PZ of the EAE, the document is indicated about proclaiming it a protected

area – Order #1114 of 03.12.1981, issue 101/1981 of the State Gazette, 1114-1981, "…aiming at preserving the population of the *Adiantum capillus-veneris* fern" [9]

Not long ago, we discovered another habitat in the city's suburbs – of a smaller area and inside an urbanized zone.

2. MATERIALS AND METHODS

2.1. Materials

In the resent research, spools were used, GPS, a guide to identify higher plants, a camera for photographing the species and the habitat.

2.2. Methods

The method of observation was applied and the methods of monitoring higher plants.

3. RESULTS

After investigating the new habitat, we submit the following characteristics.

3.1. Floristic region

The new habitat of the Adiantum capillus-veneris fern is situated in the floristic region of the Eastern Rhodopes. According to the geo-botanical division of Bulgaria (after Bondev, 1997), the flora in the territory of Kardzhali municipality falls into the European deciduous region. The Macedonian-Thracian province, the Eastern-Rhodopean district that is characterized mainly with xerothermic plant life formed by the formations of *Quercus frainetto*, *Quercus pubescens* and *Querceta virgiliana*, and in the Kardzhali region, the xeromesophytic formations of durmast, hornbeam and mixed forests and mesophytic forests of Moesian Fagus prevail.

3.2. Location

Location and GPS coordinates of the population – it is situated in an anthropogenic zone – west of Kardzhali, in the zone of cottages between the Vazrozhdentsi housing estate in the east, the dam wall in the west, the village of Krayno selo in the north and the Prileptsi housing estate in the south. (Fig. 3.).

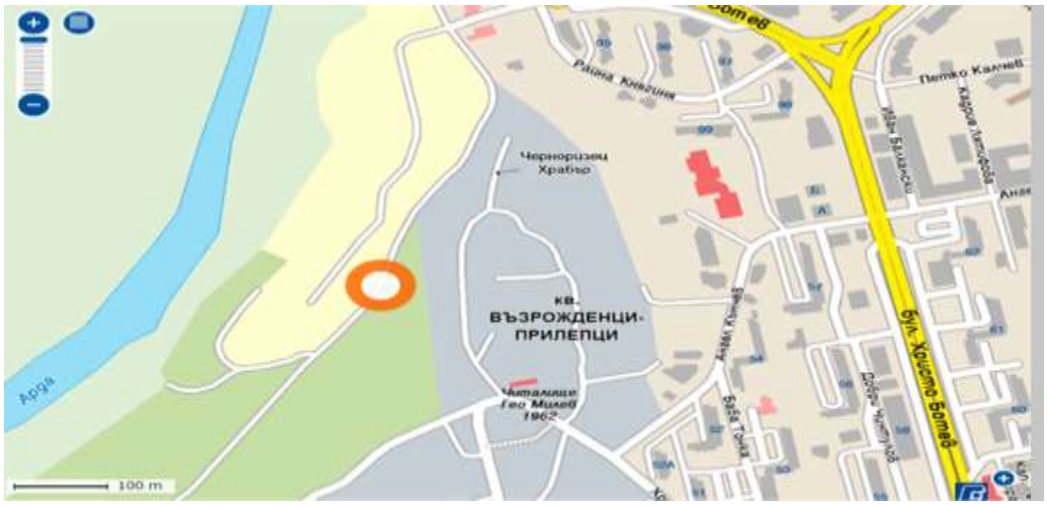


Fig. 4. A new Habitat of *Adiantum capillus – veneris* near Kardzahli

Source: https://www.bgmaps.com/map/kardjali

The GPS coordinates of the population are 41.639893 N, 25.348422 E.

3.3. Characteristics of the habitat

The habitat is located on the high side of a road that is at about a kilometer to the right along the Arda. It is on a rock with a northern, shady face. Along the rock water is sliding, which in the periphery of the habitat diminishes and defines its limits. The water gathers in a ditch that follows the road. Above the rock, private gardens are situated, and on the opposite side of the road, where the Arda is, there is a worksite, now inactive, of the Dams and Cascades company – NEC plc. The road is asphalted, one-lane, and is used by the people living in the zone of cottages.

3.3.1. Biotic factor

The accompanying vegetation are the ivy *(Hedera helix)*, fig *(Ficus carica)*, wild briar *(Rosa canina)*, nettles *(Urtica dioica)* (Fig.4.).

3.3.2. Size of the population

The habitat has a small area – 16 m in length and a height of 1,10 to 1,80. The filled-in area is about 0,0052 ha.

3.3.3. Density

The middle 8 meters are most densely overgrown and on both sides of it, due to the diminishing moisture, the density of the population decreases.

3.3.4. Invasive species

Such were not found. The accompanying vegetation is around the habitat. Most probably, the travertine favoring the fern's development is unfavorable to the other vegetation.



Fig. 5. *Adiantum capillus-veneris* - new Habitat

Source: Photograph, K. Todorova

3.3.5. Threats and negatively active factors

As a directly active negative factor the stream of passing people and automobiles could be indicated. The habitat is in an urbanized zone, easily accessible. The local pollution from unregulated dung-hills next to the fern is confirmed as of anthropogenic origin. Lethal to the habitat would be a change in the regimen of moisturizing the rocks through possible anthropogenic activities – catching or draining the waters rinsing the rock and the destruction of the neighboring vegetation or replacing it with an invasive one, the crumbling of the rock, the extraction of rock material, picking the fern as a herb or for decorative purposes. A negative influence on the population could be brought about by a climatic dry spell, too.

4. DISCUSSION

In respect of the habitats of *Adiantum capillus-veneris* in this country, measures have been taken for their preservation. The species has a conservation significance. The habitats are very small and isolated. As a critically threatened species in the Red list of higher plants in Bulgaria, *Adiantum capillus-veneris* is protected by the law. Some of the habitats are included in protected territories as the locations in the district of Kardzhali - *Adiantum capillus-veneris* habitat at Kyosh dere and "Oreshari", and protected zones by the European ecologic zone Nature 2000.

In volume 1 of the Red book "Plants and mushrooms", it is written: "The populations are intensely fragmented, few in number, with a mosaic special structure, rarely numerous and with a dense covering. Nine localities are known, but in some of them the species is probably destroyed."

In volume 3 "Natural habitats", five habitats are indicated, of which it says: "…they can only be found in the southernmost regions of Bulgaria – the Eastern and Middle Rhodopes, Slavyanka, while the sole known habitat in Western Bulgaria – near the village of Zhilentsi, district of Kyustendil, hasn't been confirmed". In one of the sources used there is mention of a habitat in the Sinite kamani nature park when it was proclaimed in 1980 [10]. At the present moment it does not exist either in the register of the EAE or the Red book. Most probably failing to take care of this rare and beautiful fern is the reason its habitats have diminished.

5. CONCLUSIONS

The current study found out yet some other smaller ferm discoveries in the outskirts of the town, in damp and rocky places. As the newly found habitat of *Adiantum capillus-veneris* is not in the register of the EAE, has not been marked as known and protected by the Haskovo RIEW nor by the protection of the environment section of Kardzhali municipality, it is necessary that measures be taken for preserving it. If possible, it should be included in the protected zones under the LBV in the territory of Kardzhali municipality, it should be included in the city's ecological map and be a spot the city's general layout should account for as it does regarding the other habitats with a special regimen of activities. Due to the habitat's being located in an urbanized zone, it is necessary to mark it in a manner that is informative and demanding the citizens' special attention and attitude, and be the object of constant monitoring and investigation.

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REFERENCES

1. RIEW – Haskovo – biological variety - <https://haskovo.riosv.com/main.php?module=info&object=info&action=view&inf_id=20>
2. RIEW – Haskovo – regional report on the state of the environment in 2017 – 2020 <https://haskovo.riosv.com/files/drugi/2018/doklad%20riosv%20hs%202017%20final.pdf>
3. Kiryakov, I 1999, *Plants systematics*, University publishing house of the Plovdiv University, Plovdiv.
4. Peev, D 2000, *The wild beauty*, Pensoft publishers, p. 46.
5. *Bulgaria's Red book*, volume 1 "Plants and mushrooms", electronic edition – Sofia, 2011 - <http://e-ecodb.bas.bg/rdb/bg/vol1/adicapil.html#map>
6. *Bulgaria's Red book*, volume 3 „Natural habitats", electronic edition – Sofia, 2011 - <http://e-ecodb.bas.bg/rdb/bg/vol3/16h3.html>
7. Report on the ecological assessment of the General layout of Kardzhali municipality 2016, <https://www.kardjali.bg/news_docs/EO%20OUP%20Kurdjali%202016-10-11.pdf>
8. EAE-„ORESHARI" <http://eea.government.bg/zpo/bg/area.jsp?nem_partition=1&categoryid=6&areaid=136>
9. EAE - Kyosh dere <http://pdbase.government.bg/zpo/bg/area.jsp?nem_partition=1&categoryid=6&areaid=62>
10. Matev, I., Ganeva, D., Ganev, D 2004, *Ecology*. Pensoft, p. 186.